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Operations Research and Machine Learning combine to solve a Harbour Security Problem

I present a successful application which unites techniques in Operations Research and in Machine learning to attack a problem in national security: How to clear a harbour that has been seeded with naval mines by an adversary. An underwater autonomous vehicle equipped with a sidescan sonar is able to identify possible mine targets. Once identified, targets may be visited by divers for further investigation and, if necessary, disarming. However, the sidescan imaging process returns many false positive contacts that in fact may simply be rocks. As diver resources are scarce and expensive, and as time to clear the harbour is a factor, it makes sense to revisit targets from a different angle to better classify targets at the UAV imaging stage.

How best to do this represents both an interesting problem in data-driven classifier theory (what is the optimal angle relative to the first one for a second or third look at a target) and an interesting travelling salesman problem in a non-traditional space obtained by adjoining 2D spatial coordinates with a view angle coordinate.

I present collaborative work between my team and the Royal Canadian Navy in which we use a unique dataset of sonar images of various real and simulated mine targets and rocks together with operational characteristics of real UAV vehicles to solve both problems.

I discuss the need for increased emphasis on game theory for the analytics toolbox, both for security problems such as this and for more traditional business analytics problems in credit scoring etc.